(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 056 263**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **82100102.1**

(22) Date of filing: **08.01.82**

(51) Int. Cl.³: **D 21 C 9/02**, D 21 D 1/40

(30) Priority: **14.01.81 SE 8100179**

(43) Date of publication of application: **21.07.82 Bulletin 82/29**

(84) Designated Contracting States: **AT CH DE FR LI**

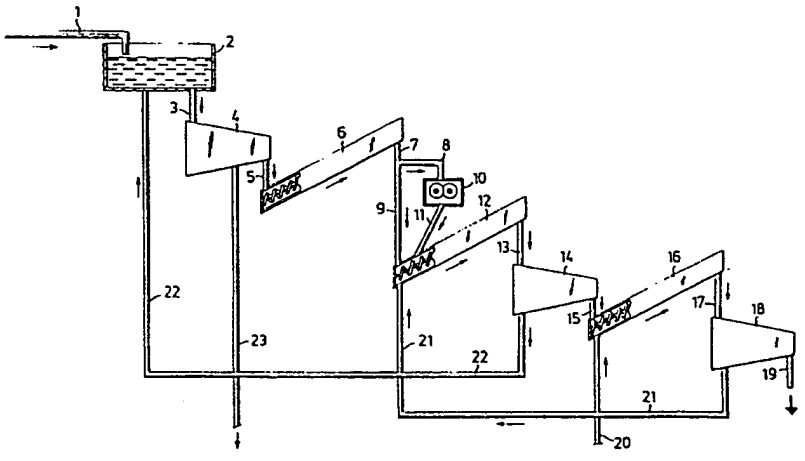
(71) Applicant: **MO OCH DOMSJÖ AKTIEBOLAG, Box 500, S-89 101 Örnsköldsvik (SE)**

(72) Inventor: **Lindahl, Jonas Arne Ingvar, Timmervägen 7, S-89200 Domsjö (SE)**

(74) Representative: **Schmied-Kowarzik, Volker, Dr., Siegfriedstrasse 8, D-8000 München 40 (DE)**

(54) A method for improving the washing of cellulose pulps produced from lignocellulosic material.

(57) To provide a cleaner pulp and to obtain a higher chemical recovery during washing of chemically cooked and optionally defibrated cellulose pulp, the partially washed pulp is subjected to a mild mechanical treatment e.g. in a device (10) adapted for high-consistency treatment and provided with screwsrotating relative to each other, said treatment taking place between at least one pair of conventional washing stages (4,14).



EP 0 056 263 A1

Technical field

The present invention relates to a method for washing cellulose pulps produced from lignocellulosic material more effectively than when applying known washing techniques, so as to improve the recovery of chemicals and combustible organic materials from the waste liquors. By cellulose pulp is meant primarily chemicals pulps, semi-chemical pulps and chemi-mechanical pulps produced from both softwood and hardwood.

Background art

In the chemical pulping of lignocellulosic material there is obtained a residue which contains inorganic chemicals and dissolved organic substances, said substances comprising mainly lignin and minor quantities of cellulose, together with extractive substances, such as resin. Undesirable residual material is washed away. The waste liquor and washing liquid obtained are evaporated and burned, normally so that the chemicals can be recovered. Thus, in order to facilitate recovery of the chemicals, a washing effluent having the highest possible dry solids content is constantly sought for, i.e. attemps are made to use the least possible amount of water during the washing process.

When producing cellulose pulps with a yield in excess of about 55%, the wood chips are normally mechanically defibrated to separate fibre form, prior to washing and/or screening the pulp. When screening the pulp, there is obtained a concentration of the non-defibrated wood residues, referred to as reject or tailings, which are normally defibrated in a separate stage to separate fibre form, and then returned to the pulp flow.

The pulp suspension obtained subsequent to delignifying the wood chips can be washed in accordance with a number of mutually differing methods known to the art. The oldest method is one in which the pulp suspension is washed in so-called diffusers, i.e. a displacement wash which is carried out batchwise in large vessels. In another method, which is common at present, the pulp suspension is washed on drum filters, normally in several stages. The number of drum filters may vary, although normally from three to four filters are used. In a further and more recent method, pulp is washed with the use of presses whereat greater volumes of liquid can be removed than when using filters, which results in a more effective recovery of chemicals and organic substances.

Disclosure of the invention

Technical problem

When applying the aforedescribed washing techniques, however, significant quantities of residual chemicals and undesirable organic substances are left in the pulp, which, when the pulp is to be subsequently bleached, results in an unnecessarily high consumption of bleaching chemicals, and causes an undesirably high quantity of substances harmful to the environment to be discharged to the surroundings. Further, an increase in the extent to which chemicals used in the cellulose processes can be recovered is also highly desirable, both from an economic and environmental aspect.

Solution

The present invention affords a solution to the aforementioned problems and makes possible an increase in the extent to which chemicals are recovered. Accordingly, the invention relates to a

method for improving the washing of unbleached cellulose pulp produced from lignocellulosic material, in which the starting material is chemically delignified (cooking) and, subsequent to being optionally mechanically defibrated is washed in a known manner in a plurality of stages, while charging water thereto. The method is characterized in that, after having been partially washed, the pulp between a pair of the washing stages or between several of said washing stages is subjected to a mild mechanical working treatment in a device adapted for high-consistency treatment and provided with relative to each other rotating screws at an energy input of from 7 to 200 kWh per ton of pulp.

When applying the method according to the invention, the cleansing effect obtained has been found to be particularly good when at least 10% of the impurities originally present in the pulp suspension are removed in the partial wash preceding the mild mechanical treatment process. In other words, at least 10% of the dry solids content of the cooking waste liquor should be washed out prior to subjecting the pulp suspension to the mild mechanical treatment process.

It has also been found particularly suitable to increase the pulp dry solids content prior to the mild mechanical treatment process, to between 10% and 50%, preferably to between 14 and 40%, and suitably to between 20 and 35%. Upon completion of the mild mechanical treatment process, the pulp suspension is diluted to a pulp consistency of between 0.5 and 13%, in conjunction with mixing with wash liquid in the subsequent washing step. When the pulp is washed on filters, the most suitable pulp consistency lies between 0.5 and 6%, while washing-dewatering in, for example, a press is suitably performed at an input pulp consistency of between 2 and 13%.

The mild mechanical treatment process according to the invention can be carried out at all temperatures normally used in practice. However, a particularly suitable temperature range is 20-110°C, while a preferred range is 35-90°C.

By mild mechanical treatment is meant here a process in which pulp suspensions of the aforementioned dry solids contents are subjected to a repeated pressing, kneading and shearing treatment, whereat the input of electrical energy for carrying out said treatment is held within the range of 7 to 200 kWh per ton of bone-dry pulp, and preferably within the range of 10 to 100 kWh per ton of bone-dry pulp.

It has been found particularly suitable to effect the mild mechanical treatment process according to the invention in a screw-type defibrator of the kind comprising two rotatable, bladed screws which are arranged parallel to one another in a housing provided with an inlet and outlet, and which are in adjustable meshing engagement with one another, to provide the mild mechanical treatment of the material, as before described. Conveniently, the screw blades of the rotatable screws also exhibit concave portions at the periphery of at least some of the screw turns, to form teeth-like protrusions between said concave portions. Screw defibrators of the aforedescribed kind are sold by MoDoMekan AB under the registered trademark FROTAPULPER®.

Advantages

The novel method according to the invention, in which the pulp suspension is mechanically treated in a mild fashion between two or more of the stages of a washing sequence, has been surprisingly found to provide a cleaner pulp and to result in higher chemical recovery, a lower discharge of impurities to the

surroundings and a higher dry solids content of the effluent washing water than was previously the case, when applying conventional washing techniques.

Thus, the present invention affords the important advantage of enabling a purer pulp to be obtained. This is manifested, inter alia, by a considerable lowering of the extractive content of the pulp and its kappa number.

The advantages afforded by the method according to the invention also include the possibility of increasing the dry solids content of the liquor departing from the pulp-washing stage, i.e. the amount of organic materials contained by said liquor, and also the amount of inorganic chemicals contained thereby. This increases the fuel value of the washing liquid, representing a valuable saving on energy. Because more contaminants are brought to evaporation and burning, and a greater amount of chemicals are recovered, the amount of environmentally harmful substances contained in the effluent is less than would otherwise be the case, which is an important advantage, and also desirable from an environmental aspect. Consequently, the cost involved in the treatment and destruction of environmentally harmful substances in the effluent can be reduced when applying the invention.

A further advantageous and surprising effect afforded by the invention is that the consumption of bleaching chemicals, such as chlorine, chlorine dioxide, hypochlorite, hydrogen peroxide and oxygen gas is markedly reduced when bleaching the washed pulp.

Another surprising effect obtained by the inclusion of the mild mechanical treatment process according to the invention, is that the dewatering of the resultant pulp suspension is markedly improved a fact which affords decisive advantages when further treating the pulp.

The advantages afforded by the method according to the invention are further illustrated by the examples shown in the description.

Brief description of the drawing

The Figure illustrates schematically a suitable embodiment of the method according to the invention applied in washing tests with birch sulphate pulp and chemi-mechanical spruce pulp in three stages, each of said stages being equipped with a press. In the tests there was installed between the first and second washing stages a screw defibrator of the kind sold under the trademark FROTAPULPER®.

Best mode of carrying out the invention

The following examples set forth experiments carried out in accordance with a preferred embodiment of the described method, together with the results obtained.

In the following tests, which were carried out in parallel, birch sulphate pulp and chemi-mechanical spruce pulp were washed in three stages, partly in accordance with the invention, incorporating said mild mechanical treatment process between the first and second washing stages (Examples 1 and 2), and partly in accordance with conventional techniques (Controls 1 and 2), in which the pulp suspensions were not subjected to any form of mechanical treatment between the different stages of the washing sequence.

The process diagram illustrated in the Figure was utilized in all tests, and hence the reference numerals below refer to corresponding references in the Figure.

Example 1

Unbleached and unwashed birch sulphate pulp was introduced through a line 1 into a tank 2, in which the pulp suspension was diluted with press waste liquor supplied through a line 22, until a pulp consistency

of about 8% was obtained. The pulp suspension was passed from the tank 2 through a line 3 to a first washing stage 4, comprising a press, in which the pulp suspension was thickened to a dry solids content of 33.3% and then passed through a line 5, to a screw feeder 6, arranged to feed the pulp suspension through a line 7 and a line 8 to a screw defibrator 10 provided with two rotating screws whose blades exhibited concaved portions and in which the pulp suspension was subjected to a mild mechanical treatment process, whereafter said suspension was passed to a second screw feeder 12 through a line 11. The temperature of the pulp suspension at the inlet to the screw defibrator 10 was measured as 68°C, and at the outlet of said defibrator as 71°C. The amount of electrical energy consumed by the mild mechanical treatment process in the screw defibrator 10 was measured to 15 kWh per ton of bone-dry pulp. The line 9 was closed while passing the pulp suspension through the defibrator 10.

The treated pulp suspension was diluted in the screw feeder 12 to a pulp consistency of 8%, by introducing press waste liquor to said feeder through a line 21, said waste liquor mixing effectively with the pulp suspension during its transport through the feeder 12. The diluted pulp suspension was then passed through a line 13 to a second washing stage 14, comprising a press similar to that used in the first washing stage. The pulp suspension was washed and again thickened in the press 14, to a dry solids content of 33.3%. Waste liquor obtained from the press 14 was passed through a line 22 to the tank 2, where it was used to dilute incoming pulp suspension. The pulp suspension, washed and thickened in the second washing stage, was then passed through a line 15 to a screw feeder 16, and through a line 17 to a third washing stage equipped with a press 18 similar to the presses used in the two preceding washing stages.

The pulp suspension was diluted and mixed in the screw feeder 16 in a manner similar to that in the preceding screw feeder 12, although in this case with pure water supplied through a line 20, to obtain a pulp consistency of 8%. Subsequent to washing the pulp suspension and thickening the same to a dry solids content of 33.3% in the press 18, the finally washed pulp suspension was removed through a line 19.

Press waste liquors were removed from the lines 21 and 22 during the tests, for analysis purposes. Samples of the finally washed pulp were also taken from the line 19. The analysis results are shown in Table 1. Waste liquor from the press in the first washing stage 4 was taken through a line 23 and passed to a recovery plant (not shown in the drawing), where said waste liquor was evaporated and burned. Because the washing liquid was passed in counter-flow to the flow of pulp suspension, and because of the mechanical treatment to which the pulp suspension was subjected, the press waste liquor had a high organic-substance content (about 13%) and, at the same time, a high fuel value.

Control test 1

In this test there was washed a birch sulphate pulp taken from the same batch as the pulp used in Example 1 and treated in the same apparatus, although with the difference that the pulp suspension was not subjected to a mild mechanical treatment process between the first and second washing stages. Thus, all flow of pulp suspension through the line 8 was stopped, so that the pulp suspension passed instead directly to the second screw feeder 12, through the line 9.

Subsequent to washing and thickening the pulp suspension in the press 14 of the second washing stage, there was obtained in this case a dry solids content of 26%. After washing and thickening the suspension in the press 18 of the third washing

stage, there was also obtained a dry solids content of 26%. It will be noted that the consistency of the pulp suspension at the inlets to presses 14 and 18 respectively was also 8% in this test, and that the pressure exerted by the presses was the same as that in Example 1.

Analysis samples were removed in this test at the same locations as in the test according to Example 1. The analysis results are shown in Table 1 below.

Table 1

Dry solids content of pulp suspension	Control test 1	Example 1
subsequent to passing the press of the 2nd washing stage, %	26.0	33.3
subsequent to passing the press of the 3rd washing stage, %	26.0	33.3
Amount of press waste liquor obtained from:		
the press of the 2nd washing stage, m^3/ton	8.65	9.50
the press of the 3rd washing stage, m^3/ton	8.65	9.50
Dry solids content of press waste liquor from:		
the press of the 2nd washing stage, %	3.50	3.70
the press of the 3rd washing stage, %	1.62	1.89
Sodium content of the press waste liquor from:		
the press of the 2nd washing stage, g/l Na	6.55	7.02
the press of the 3rd washing stage, g/l Na	2.83	3.38
Totally washed from the pulp suspension in the 2nd and 3rd washing stages:		
as dry solids, kg per ton bone-dry pulp	450.0	532.0
as Na, kg per ton bone-dry pulp	80.9	98.5
Properties of finally washed pulp:		
Extractives content (according to SCAN:C7:62) DCM (dichloromethane) %	0.34	0.18
Viscosity (according to SCAN-C15:62) cm^3/g	972	969
Kappa number (according to SCAN-C1:59)	17.5	14.7

As will be seen from the Table, when applying the method according to the invention quite surprisingly a considerably better washing was obtained than can be obtained when washing in accordance with known techniques. Thus has for example despite the fact that the mild mechanical treatment process was carried out on a pulp suspension which had only been partially washed, the method according to the invention surprisingly resulted in a pulp with a much lower extractives content than can be obtained when conventionally washing pulp without mechanically treating the pulp between washing stages.

One important advantage with respect to energy afforded by the increased extent to which organic substances are washed from the pulp is that the fuel value of the waste liquor is also increased. Further a higher percentage of the cooking chemicals are recovered.

Example 2

The test described in Example 1 was repeated with chemi-mechanical spruce pulp cooked to a pulp yield of 73%, calculated on absolute dry wood. After washing the pulp suspension and thickening the same in the press 14 of the second washing stage, there was obtained in this test a dry solids content of 34%. A dry solids content of 34% was similarly obtained after washing and thickening the pulp in the press 18 of the third washing stage. The line 9 was closed when making this test.

Control test 2

In this test a similar type of chemi-mechanical spruce pulp was washed, and treated in the same plant as that used in Example 2, although with the difference that the pulp suspension was not subjected to any form

of mild mechanical treatment between any of the washing stages. Thus all flow of pulp suspension through the line 8 was stopped, so that the pulp suspension instead passed directly to the second screw feeder 12, through the line 9. Subsequent to passing the press 14 of the second washing stage, the dry solids content was found to be 30%. The dry solids content was also found to be 30% after passing the press 18 of the third washing stage.

When making a comparison between washing the pulp in accordance with known techniques and washing the pulp in accordance with the present invention, it can be concluded that more water is removed and more chemicals recovered when practicing the method according to the invention. This conclusion is based on the fact that the volume of waste liquor recovered when applying the present invention was greater, despite the fact that the consistencies of the pulp suspensions entering the presses, in both tests, were maintained constant at 7%. According to measurements taken, the washing water in Example 2 also contained slightly larger quantities of dry solids than the washing water in Control test 2. Thus, it can be established that the fuel values of the liquors obtained when applying the method according to the invention are higher than the fuel values of corresponding liquors obtained when washing chemi-mechanical pulp in accordance with conventional techniques.

CLAIMS

1. A method for improving the washing of unbleached cellulose pulp when producing cellulose pulps from lignocellulosic material, in which the starting material is chemically delignified and, subsequent to being optionally mechanically defibrated, is washed, in a known manner, in a plurality of stages while supplying water thereto, c h a r a c t e r i z e d i n, that the pulp, after having been partially washed, between a pair of the washing stages or between several of said washing stages is subjected to a mild mechanical working treatment in a device adapted for high-consistency treatment and provided with relative to each other rotating screws at an energy input of from 7 to 200 kWh per ton of pulp.

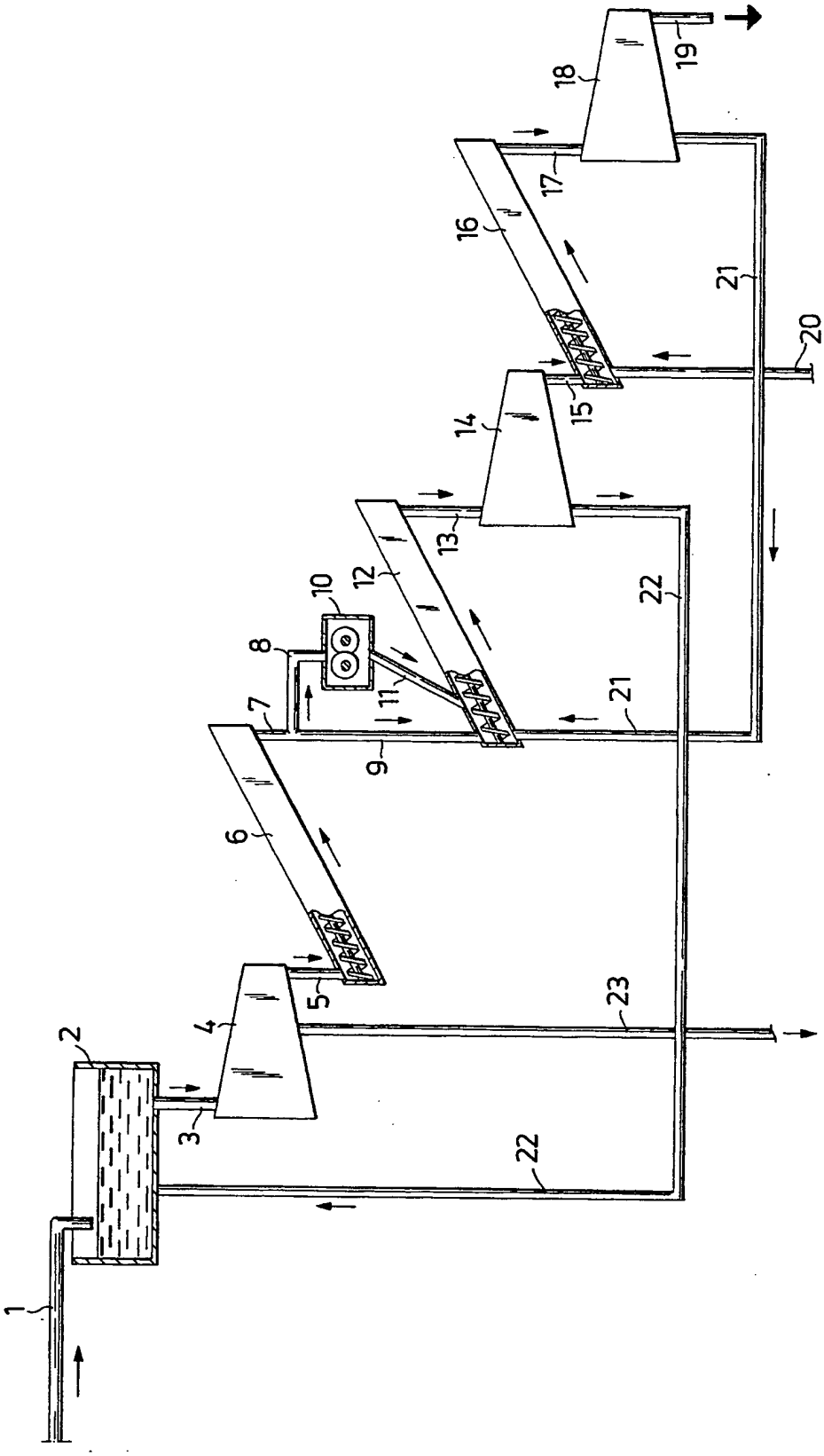
2. A method according to Claim 1, c h a r a c t e r i z e d i n, that at least 10% of the dry solids content of the cooking waste liquor is removed during the partial washing step preceding the mild mechanical treatment process.

3. A method according to Claims 1 and 2, c h a r a c t e r i z e d i n, that the mild mechanical treatment process is carried out at a pulp dry solids content of between 10 and 50%, preferably between 14 and 40% and suitably between 20 and 35%.

4. A method according to Claims 1-3, c h a r a c t e r i z e d i n, that the electrical energy input to the mild mechanical treatment process is held within the range of 10 to 100 kWh/ton.

5. A method according to Claims 1-4, c h a r a c t e r i z e d i n, that the mild mechanical treatment process is carried out in a screw defibrator -

of the kind comprising two rotatable, bladed screws which are arranged parallel to one another in a housing provided with an inlet and an outlet and which engage in each other for mildly treating the material, and the screw blades of which exhibit concave portions on the periphery of at least some screw turns to form tooth-like protrusions between said concave portions.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

European Patent Office

EUROPEAN SEARCH REPORT

0056263
Application number
EP 82 10 0102

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	EP - A - 0 017 544 (CREUSOT-LOIRE) * claims 1-3; figures 1-4; page 3, line 19 - page 4, line 25; page 5, line 35 - page 10, line 24 *	1-3,5	D 21 C 9/02 D 21 D 1/40
A	TAPPI JOURNAL OF THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, vol. 62, no. 8, August 1979 ATLANTA, GA, US B. VIKSTRÖM: "Defibration in high-yield kraft pulping. Influence of degree of washing on the physical properties of cooked wood chips and on the results of defibration" pages 69-72 * entire article *	1	TECHNICAL FIELDS SEARCHED (Int.Cl. 3) D 21 C D 21 D

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same category
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14-04-1982	NESTBY

EPO Form 1503.1 06.78